SOAH DOCKET NO. 582-07-2673
TCEQ DOCKET NO. 2007-0204-WDW

| | | |
|---|---|---|
| APPLICATION OF TEXCOM GULF DISPOSAL, L.L.C. FOR TEXAS COMMISSION ON ENVIRONMENTAL QUALITY UNDERGROUND INJECTION CONTROL PERMIT NOS. WDW 410, WDW411, WDW412 AND WDW 413 | § | BEFORE THE STATE OFFICE OF ADMINISTRATIVE HEARINGS |

SOAH DOCKET NO. 582-07-2674
TCEQ DOCKET NO. 2007-0362-IHW

| | | |
|---|---|---|
| APPLICATION OF TEXCOM GULF DISPOSAL, L.L.C. FOR TEXAS COMMISSION ON ENVIRONMENTAL QUALITY INDUSTRIAL SOLID WASTE PERMIT NO. 87758 | § | BEFORE THE STATE OFFICE OF ADMINISTRATIVE HEARINGS |

---

# SUPPLEMENTAL PRE-FILED TESTIMONY OF GREG CASEY, P.E.

## ON BEHALF OF APPLICANT TEXCOM GULF DISPOSAL, LLC

---

TexCom Ex. 84

## TABLE OF CONTENTS

**SOAH DOCKET NO. 582-07-2673**
**TCEQ DOCKET NO. 2007-0204-WDW**

| | | |
|---|---|---|
| **APPLICATION OF TEXCOM GULF DISPOSAL, L.L.C. FOR TEXAS COMMISSION ON ENVIRONMENTAL QUALITY UNDERGROUND INJECTION CONTROL PERMIT NOS. WDW 410, WDW411, WDW412 AND WDW 413** | § | **BEFORE THE STATE OFFICE OF ADMINISTRATIVE HEARINGS** |

**SOAH DOCKET NO. 582-07-2674**
**TCEQ DOCKET NO. 2007-0362-IHW**

| | | |
|---|---|---|
| **APPLICATION OF TEXCOM GULF DISPOSAL, L.L.C. FOR TEXAS COMMISSION ON ENVIRONMENTAL QUALITY INDUSTRIAL SOLID WASTE PERMIT NO. 87758** | § | **BEFORE THE STATE OFFICE OF ADMINISTRATIVE HEARINGS** |

# SUPPLEMENTAL PRE-FILED TESTIMONY OF GREG CASEY, P.E. ON BEHALF OF APPLICANT TEXCOM GULF DISPOSAL, LLC

## I. BACKGROUND

Q: PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A: My full name is Bryan Greg Casey, although I usually go by Greg. My business address is ALL Consulting, 6022 Charrington Dr., Spring, Texas 77389.

Q: HAVE YOU PREVIOUSLY TESTIFIED ON TEXCOM'S BEHALF IN THESE PROCEEDINGS?

A: Yes, my pre-filed direct case testimony was marked as TexCom Ex. 49.

Q: WOULD YOU REMIND US OF YOUR OCCUPATION?

A: I am a Principal Engineer with ALL Consulting, and Vice President and Manager of ALL Consulting's Houston Office. ALL Consulting is a professional services firm composed of engineers, scientists and planners, and specializing in environmental sciences/planning, earth sciences, and technology. We have offices in Tulsa, Oklahoma; Edwardsville, Illinois; Wichita, Kansas; and Houston, and currently have approximately 35 employees and shareholders.

Q: PLEASE REMIND US OF THE RELATIONSHIP BETWEEN ALL CONSULTING AND TEXCOM GULF DISPOSAL, LLC.

A: In February 2005, TexCom Gulf Disposal, LLC ("TexCom") hired ALL Consulting as an independent consultant to provide technical support and assist in the preparation of underground injection control ("UIC") permit application materials for its proposed non-hazardous wastewater treatment and disposal facility in Montgomery County.

Q: PLEASE REMIND US OF YOUR ROLE IN THE PREPARATION OF THOSE APPLICATION MATERIALS.

A: I was the project lead, and supervised the preparation of the application materials prepared by ALL Consulting. I performed the engineering design work for the project, lead the geological and hydrogeological evaluations performed by ALL Consulting, and provided assistance to TexCom on virtually all technical aspects of the project. I also affixed my Professional Engineer's seal to the technical report contained in the Application.

Q: IN YOUR ORIGINAL PRE-FILED TESTIMONY YOU ANSWERED MANY QUESTIONS ABOUT YOUR EDUCATION AND EXPERIENCE. I WILL NOT ASK YOU TO ANSWER THOSE QUESTIONS AGAIN, BUT, FOR THE SAKE OF REMINDING US OF YOUR BACKGROUND, PLEASE GENERALLY DESCRIBE YOUR RELEVANT PROFESSIONAL EXPERIENCE.

A: I have over 21 years of experience managing a diverse range of projects and programs in the environmental water resources and petroleum industries. My current work principally consists of leading teams of engineers and geologists in developing well and surface facility designs and permit applications for Class I and Class II injection wells. I have managed, provided initial design, and supervised the final design and permitting of 15 Class I injection wells for facilities in Texas, Oklahoma and California. This included drill plan preparation, hydrogeology and geology study of area, geologic modeling review of the waste plume and injection formation parameters, and management and senior technical oversight of the permitting and testing of the wells.

**MR. CASEY WAS PREVIOUSLY ADMITTED, WITHOUT OBJECTION, AS AN EXPERT IN THE PERMITTING, DESIGN, CONSTRUCTION AND OPERATION OF UIC FACILITIES, INCLUDING THE ASSOCIATED GEOLOGICAL AND HYDRO-GEOLOGICAL ANALYSES.**

## II. PURPOSE OF SUPPLEMENTAL TESTIMONY

Q: WHAT IS THE PURPOSE OF YOUR SUPPLEMENTAL DIRECT TESTIMONY?

A: To present the results of a modeling exercise I performed in March 2009, the purpose of which was to comply with the Commission's Interim Order dated December 12, 2008 calling for "an analysis to be conducted using the 80.9 millidarcy permeability, and an assumption that the fault in question is non-transmissive in the horizontal direction." I will also present and discuss the results of a fall-off test conducted at the existing Well WDW-315 (proposed to be re-permitted as WDW-410) in September of 2009.

Q: BEFORE DISCUSSING YOUR MARCH, 2009 MODELING EXERCISE, HOW DO YOU VIEW THE TWO MODELING ASSUMPTIONS SPECIFIED BY THE INTERIM ORDER?

A: While it is true that a fall-off test conducted when proposed WDW-410 was drilled in 1999 indicated a permeability of 80.9 md, as I have previously explained, in order to improve permeability, TexCom had always planned to re-perforate proposed WDW-410 across 45 additional feet of clean, non-shaley sand intervals within the Lower Cockfield at a density of 6 shots-per-foot, and increase the density of the perforations for the existing 100-foot section from 2 shots-per-foot to 4 shots-per-foot. In September of 2009, TexCom had proposed WDW-410 re-perforated as planned and conducted a fall-off test, which indicated an injection interval permeability of 190.6 md. This is obviously higher than the 80.9 md assumption TexCom was required to use in its modeling analysis by virtue of the Commission's Interim Order. And, actually, I believe that the permeability of the injection interval may prove to be even higher than 190.6 md through future testing.

As for the fault located 4,400 feet south of the site (EW-4400-S), I continue to believe it is transmissive in the horizontal direction. As I previously testified, the fault movement probably caused smearing of the clay on the formation which would inhibit fluid movement across the fault to some degree. However, during the December, 2007 hearing, Mr. Langhus testified that at the time of virgin reservoir conditions (i.e., before oil production had begun in the area), the oil/water contact was at the exact same depth, 4,990 feet below the surface, on either side of the fault. This is very strong evidence that the fault is horizontally transmissive.

For these reasons, I believe the two modeling assumptions specified by the Commission in its Interim Order are overly conservative. Nonetheless, for the purpose of fulfilling the requirements of the Interim Order, I input both assumptions in my March 2009 modeling exercise.

Q: DOES YOUR MARCH, 2009 MODELING EXERCISE REPRESENT AN AMENDMENT TO TEXCOM'S PENDING APPLICATION?

A: No, TexCom is not amending the Application. TexCom merely retained me to conduct another modeling exercise to satisfy the Commissioners' remaining concerns before issuing the permit.

Q: DO YOU INTEND FOR YOUR SUPPLEMENTAL DIRECT TESTIMONY TO REPLACE THE TESTIMONY YOU HAVE PREVIOUSLY GIVEN IN THESE PROCEEDINGS?

A: No. I intend for this direct testimony to supplement my previous testimony.

## III. RESULTS OF MARCH 2009 MODELING

Q: I AM SHOWING YOU WHAT HAS BEEN MARKED AS TEXCOM EX. 85. COULD YOU PLEASE IDENTIFY THIS DOCUMENT?

A: Yes, it is a true and correct copy of my March 2009 modeling report summarizing the new modeling exercise I performed in accordance with the Commission's Interim Order.

Q: DO YOU ADOPT THE STATEMENTS IN THAT MODELING REPORT AS YOUR SWORN TESTIMONY IN THIS CASE?

A: Yes.

**APPLICANT OFFERS TEXCOM EX. 85.**

Q: IN CONDUCTING THE MARCH 2009 MODELING, DID YOU FOLLOW THE SAME PROCEDURES YOU FOLLOWED IN CONDUCTING THE MODELING IN TEXCOM'S APPLICATION?

A: Yes, all of my methodologies were the same, with the exception of the two modeling inputs we have been discussing. I described these methodologies at length in my prior testimony in this case.

Q: WHAT WERE THE RESULTS OF THE MARCH 2009 MODELING?

A: The March 2009 modeling determined that, even with the two conservative assumptions we have been discussing, and even if TexCom were to inject at maximum permitted rates continuously for 30 years, the reservoir pressure at the wellbore would increase over 30 years to a maximum of only 3,897 pounds per square inch ("psi"), which is still lower

than the bottom hole fracture pressure, or the pressure that could theoretically cause fracture of the formation, of 4,848 psi. Additionally, the March 2009 modeling determined, based on the same conservative assumptions, that the plume radius after 30 years would be, at most, 2,770 feet from the wellbore, which is the same as the plume radius determined by the modeling from TexCom's Application. This is due to the fact that the waste plume does not reach the fault during the 30 years of injection. Finally, if the March 2009 modeling were determinative of the Area of Review ("AOR") for TexCom's Application, the AOR would be expanded from 2.5 miles to 2.94 miles.

Q: PLEASE ELABORATE ON THE EXPANSION OF THE AOR.

A: Recall that the AOR is defined as the area surrounding an injection well, or group of injection wells, for which a UIC permit applicant performs a review of certain information, primarily concerning artificial penetrations. TCEQ's rules, at 30 TEX. ADMIN. CODE § 331.42, define the AOR as being an area determined by a radius of 2.5 miles from the proposed or existing wellbore, or the area within the cone of influence, whichever is greater. The cone of influence, again, is the area within which the reservoir pressure build-up over the lifetime of the facility is sufficient to, theoretically, displace drilling mud in an unplugged abandoned well exposed to that pressure build-up.

The modeling originally done in support of TexCom's Application determined the cone of influence to be 750 feet. Because this was less than 2.5 miles, the AOR was determined to be the minimum 2.5 miles under § 331.42. Because of the much lower assumed permeability and the assumption that the EW-4400-S fault was non-transmissive, the March 2009 modeling conservatively calculated the pressure-build up to

occur more quickly, causing the cone of influence, and consequently, the AOR, to extend out to 2.94 miles from the wellbore.

## IV. WELL LOCATIONS WITHIN 2.94-MILE AREA OF REVIEW

Q: I AM SHOWING YOU WHAT HAS BEEN MARKED AS TEXCOM EX. 86. COULD YOU PLEASE IDENTIFY THIS DOCUMENT?

A: Yes, it is a true and correct copy of a base map showing oil and gas well locations within a 2.94-mile AOR as indicated on various maps kept on file by the Railroad Commission of Texas. This was prepared under my supervision as Figure 6 to the March 2009 modeling report.

**APPLICANT OFFERS TEXCOM EX. 86.**

Q: WHAT IS THE BASIS FOR THE INFORMATION CONCERNING WELL LOCATIONS DEPICTED ON TEXCOM EX. 86?

A: TexCom Ex. 86 was developed under my supervision from various maps of oil and gas and disposal wells kept by the Railroad Commission of Texas.

Q: ON TEXCOM EX. 86, WHAT DOES THE DIAGONAL BLACK LINE REPRESENT?

A: The black line represents the EW-4400-S fault. Notice that 253 of the indicated well locations within the 2.5-mile AOR from TexCom's Application are south of the EW-4400-S fault, which is consistent with the fact that the center of the salt dome, and, consequently, the center of hydrocarbon production, is to the south/southwest of the site. If the operating assumption is that the fault is horizontally non-transmissive, then all of

the 253 indicated penetrations within the AOR, but south of the EW-4400-S, can be disregarded on the sole basis that the injected wastewaters could not migrate south of the fault and potentially reach them. Thus, even though the AOR is hypothetically expanded to 2.94 miles when the two modeling assumptions set forth in the Interim Order are made, the net effect is a significant *reduction* (from 505 to 262) in the number of well locations within the AOR.

Q: HOW MANY ADDITIONAL WELL LOCATIONS DID YOU IDENTIFY WITHIN THE ADDITIONAL 0.44-MILE BAND SURROUNDING THE 2.5-MILE AOR FROM TEXCOM'S APPLICATION?

A: As explained at page 12 of the March 2009 modeling report, the Railroad Commission's maps show 10 well locations north of the EW-4400-S fault within 2.5 and 2.94 miles from the TexCom wellbore.

Q: DID YOU PERFORM A WELL RECORD SEACH FOR THOSE 10 WELL LOCATIONS?

A: Yes. I was able to locate well records for 9 of the 10. I could not locate any well records for the one labeled as RM-2. The only identifying information for this well location is a hand-drawn dot on a USGS map located in the Railroad Commission's files. Because there are no records of it having been completed, and because it does not appear on other Railroad Commission maps, I do not believe the well location labeled as RM-2 was ever actually drilled.

Q: IS THERE ANYTHING ABOUT THE 2.94-MILE AOR, OR ANY OTHER ASPECT OF THE MARCH 2009 MODELING, THAT WOULD CAUSE YOU TO DOUBT YOUR PREVIOUSLY STATED CONCLUSIONS ABOUT TEXCOM'S PROPOSED PROJECT?

A: No. Even if the permeability of the injection interval were 80.9 md and the EW-4400-S fault is horizontally non-transmissive, there is nothing about the 2.94-mile AOR or any other aspect of the March 2009 modeling that would cause me to doubt my previously stated conclusions. As I explained earlier, this modeling scenario actually *reduces* the number of relevant well locations within the AOR, and there is nothing concerning or distinctive about the 9 additional well locations located between 2.5 and 2.94 miles from the wellbore.

Q: BUT ISN'T IT TRUE THAT, IF THE MODELING ASSUMPTIONS WERE CORRECT, THERE WOULD BE SIGNIFICANTLY MORE WELL LOCATIONS WITHIN THE MODELED CONE OF INFLUENCE?

A: Yes, but remember that the modeled cone of influence is the result of several extremely conservative assumptions, including an assumption that TexCom will be injecting at maximum rates, 24 hours a day, 365 days a year, continuously for 30 years, without any interruption that would allow the underground pressures to dissipate. Because these conservative assumptions and others I have previously discussed are not realistic, the actual cone of influence is much, much smaller than the modeled cone of influence.

But even if, hypothetically speaking, all of the modeling assumptions were accurate, and therefore the actual cone of influence were to expand over the next 30 years and

eventually reach the bounds of the modeled cone of influence, there are still a number of reasons why the artificial penetrations within the cone of influence could not act as conduits for upward migration, the most obvious being that none of the wells in the area are completed in the Lower Cockfield, the interval into which TexCom proposes to inject.

Recall that the Cockfield consists of four separate parts: **(1)** the Cockfield Shale Member (starting at 6,390 feet and extending deeper), **(2)** the Lower Cockfield Member (6,045 to 6,390 feet), **(3)** the Middle Cockfield Member (5,629 to 6,045 feet) and **(4)** the Upper Cockfield Member (5,134 to 5,629 feet). Layers of shale separate the Cockfield Members and prevent injected wastewater or any other substances from passing vertically between them. Therefore, in order for an artificial penetration to serve as an upward conduit, it would have to, among other requirements, be completed and open to the Lower Cockfield.

All of the historical oil production in the Conroe Oil Field, which was discovered in 1931 and operated by a single operator for virtually its entire lifespan, has been not from the Lower Cockfield, but from the Upper Cockfield. Even if the field operator had drilled a well to a lower depth looking for oil, the operator would have plugged that well back to the Upper Cockfield with cement or mechanical plugs in order to prevent the inward flow of brine from the lower zones. Additionally, as of the early 1930s, the standard practice for abandoning oil wells was to plug them with cement; therefore, regardless of any particular well's depth, if it is abandoned, it is almost certainly plugged with cement.

Because of the nature of oil production and subsurface geology in the Conroe Oil Field, the size of the cone of influence really does not matter. As long as it does not extend beyond the boundaries of the Conroe Oil Field, it can be safely concluded that any abandoned wells within the cone of influence will be completed in or plugged back to the Upper Cockfield and, therefore, not capable of coming into contact with the wastewater plume in the Lower Cockfield.

Finally, if the EW-4400-S fault is non-transmissive, there simply isn't a means of communication from the Lower Cockfield to the Middle Cockfield, much less the Upper Cockfield.

Q: ARE YOUR STATEMENTS CONCERNING THE NATURE OF THE WELLS IN THE CONROE OIL FIELD SUPPORTED BY WELL RECORDS?

A: To the extent well records are available, yes. In preparing to testify again in this case, I re-visited the Railroad Commission's files and, with the assistance of Bobbi Coughlin, a colleague at ALL Consulting, attempted to locate records for all of the well locations within the hypothetical 2.94-mile AOR. As I expected would be the case, there were a few well locations for which no Railroad Commission records exist, suggesting that they were never actually drilled and exist only as dots on a map. But for each of the hundreds of well locations for which records do exist, the records show that the wells, if actually drilled, were either completed in the Upper Cockfield or abandoned and plugged with cement.

Q: I AM SHOWING YOU WHAT HAS BEEN MARKED AS TEXCOM EX. 87. COULD YOU PLEASE IDENTIFY THIS DOCUMENT?

A: Yes, this is a compilation of the all of the well records for well locations within the 2.94-mile AOR we were able to identify within the Railroad Commission's files.

**APPLICANT OFFERS TEXCOM EX. 87.**

Q: NOW I AM SHOWING YOU WHAT HAS BEEN MARKED AS TEXCOM EX. 88. COULD YOU PLEASE IDENTIFY THIS DOCUMENT?

A: Yes, this is a spreadsheet, prepared under my direct supervision, summarizing the information contained in the Railroad Commission well records we reviewed. As you can see, for all but four of the wells for which records exist, the completed depth is within the Upper Cockfield, usually around 5,100 feet. There are only four wells not completed in the Upper Cockfield, C57, C82, C461 and RM5, and the records for each of these wells shows that they were, as I would have expected, dry holes and plugged with cement.

**APPLICANT OFFERS TEXCOM EX. 88.**

Q: FOR SEVERAL OF THE WELL LOCATIONS LISTED ON TEXCOM EX. 88, THE DEPTH IS LISTED AS "NOT DRILLED." WHAT IS YOUR BASIS FOR BELIEVING THEY WERE NOT DRILLED?

A: After a very exhaustive search using all the available resources at the RRC office in Austin, including help from a number of RRC personnel, the records for these well locations were not located. The RRC personnel indicated that the locations were most likely operator reported proposed drilling locations that were never drilled. Had they

been drilled, a drilling/completion, or other record would have been submitted by either the operator or the RRC district personnel.

Q: ON TEXCOM EX. 88, WELL LOCATIONS C-389, C-438 AND RM-2 ARE MARKED WITH A NOTATION OF "UNLOCATABLE." WHAT DOES THAT MEAN?

A: It means that neither I, my ALL Consulting colleague, nor employees at the Railroad Commission could locate any records for the well locations in the file system. RRC personnel indicated that these wells were possibly filed incorrectly.

Q: TWO OTHER WELL LOCATIONS, C-427 AND C-428, ARE MARKED WITH A NOTATION OF "NO RECORD IN RCC." WHAT DOES THAT MEAN?

A: It means that these two well locations showed up on a generated map, but do not show up in any Railroad Commission database.

Q: FOR THE FIVE WELL LOCATIONS WITHIN THE HYPOTHETICAL 2.94-MILE AOR FOR WHICH THERE ARE NO RAILROAD COMMISSION RECORDS (C-389, C-427, C-428, C-438 AND RM-2), HOW CAN WE BE SURE THEY WILL NOT SERVE AS UPWARD CONDUITS FOR MIGRATION?

A: Because there are no records for them, I am not sure any of these wells even exist, but if they do, there are several reasons to believe they could not serve as upward conduits. First, as I have said, despite the lack of well records, it can be safely concluded that they would have been either completed in the Upper Cockfield or plugged back to the Upper Cockfield. The Conroe Oil Field has had a single operator for its entire existence, 100% of oil production has been in the Upper Cockfield, and there was a strong economic

incentive to plug deeper dry holes back to the Upper Cockfield so as to prevent the inward flow of brine from the lower zones. Indeed, with the exception of the four cement-plugged dry holes I mentioned earlier, *all* of the available records for the hundreds of wells within the AOR show completion in the Upper Cockfield. There is simply no reason to believe the operator would have left any wells open to the Lower Cockfield. Second, the wells would have been plugged with cement, as it was standard practice to do so in this field. Third, if there were abandoned wells that had been drilled through the Jackson Formation, and that lacked adequate casing and were not plugged with cement, they would not have been able to withstand the pressures exerted by the surrounding mudstone of the Jackson Formation, and would have collapsed within a matter of years. For all of these reasons, I am confident that there are no open conduits from the Lower Cockfield at 6,045 to 6,390 feet below the surface to the aquifers beginning at 4,088 feet.

Q: TO ANSWER THE QUESTION POSED BY THE COMMISSION IN ITS INTERIM ORDER, EVEN IF THE PERMEABILITY OF THE INJECTION INTERVAL WERE 80.9 MD, AND EVEN IF THE EW-4400-S FAULT IS HORIZONTALLY NON-TRANSMISSIVE, WOULD THERE BE ANY POSSIBILITY OF WASTEWATERS INJECTED BY TEXCOM MIGRATING UPWARD INTO THE AQUIFERS STARTING AT 4,088 FEET BELOW THE SURFACE?

A: For all the reasons given above and in my previous testimony, no.

## V. SEPTEMBER 2009 FALL-OFF TEST

Q: YOU MENTIONED EARLIER THAT ALL CONSULTING CONDUCTED A FALL-OFF TEST AT PROPOSED WDW-410 IN SEPTEMBER OF 2009. PLEASE REMIND US, WHAT IS A FALL-OFF TEST?

A: A fall-off-test is a method for determining the permeability and other characteristics of a geological formation into which wastewaters will be injected at the bottom of an injection well. It is performed by injecting a known volume of liquid, in this case a brine solution, at known injection rates and under known injection pressures, observing the rate at which the down-hole pressures "fall-off" as the injected fluid is absorbed into the formation, and calculating from that information the formation's permeability and other characteristics.

Q: WHAT WAS THE PURPOSE OF THE FALL-OFF TEST CONDUCTED IN SEPTEMBER 2009 AT PROPOSED WDW-410?

A: It was done primarily to determine what the permeability of the injection interval would be after proposed WDW-410 was re-perforated as proposed in TexCom's application. Normally, this type of testing is done after a well has been permitted, and is used to determine whether the applicant's pre-permitting modeling assumptions were sufficiently conservative, or whether the cone of influence and area of review needs to be re-calculated based on the test results prior to receiving final authorization to inject from TCEQ's Executive Director. In this case, since proposed WDW-410 had already been drilled, and the permeability of the injection interval had been the subject of controversy at the first SOAH hearing, TexCom decided to have proposed WDW-410 re-perforated and conduct a fall-off test prior to the receiving Class I authorization from TCEQ.

Q: IS THE SEPTEMBER 2009 FALL-OFF TEST THE SAME TYPE OF TEST THAT SOAH RECOMMENDED BE SPECIFICALLY REQUIRED BY ADDITIONAL PERMIT CONDITIONS IN ITS APRIL 25, 2008 PFD?

A: Yes. Proposed Conclusion of Law No. 51 stated that the UIC permits should be granted with additional conditions specifying that proposed WDW-410 be re-perforated between 6,045 and 6,390 feet, that a fall-off test be conducted, and that the results of the fall-off test be used to re-calculate the cone of influence. This has all been done now, and so to the extent those additional special conditions recommended by SOAH were ever necessary, they are no longer so.

Q: UNDER WHAT AUTHORIZATION WAS PROPOSED WDW-410 RE-PERFORATED AND THE FALL-OFF TEST PERFORMED?

A: A Class V authorization, which was granted by TCEQ pursuant to Chapter 331 of its rules by letter dated July 23, 2009. Class V authorizations, sometimes called workover authorizations, are used to authorize certain types of activities such as re-perforations and other down-hole work at previously-drilled injection wells.

Q: DID YOU PREPARE TEXCOM'S APPLICATION FOR THE CLASS V AUTHORIZATION?

A: Yes.

Q: I AM SHOWING YOU WHAT HAS BEEN MARKED AS TEXCOM EX. 89. COULD YOU PLEASE IDENTIFY THIS DOCUMENT?

A: Yes, this is a true and correct copy of the revised application for a Class V authorization, which I prepared and submitted to TCEQ on TexCom's behalf on June 12, 2009. Note that this submittal included the complete application, revised to address issues raised by a notice of deficiency issued by TCEQ in response to the original version of the application, which had been submitted on May 5, 2009.

**APPLICANT OFFERS TEXCOM EX. 89**

Q: I AM SHOWING YOU WHAT HAS BEEN MARKED AS TEXCOM EX. 90. COULD YOU PLEASE IDENTIFY THIS DOCUMENT?

A: Yes, this is a true and correct copy of the July 23, 2009, letter by which TCEQ granted a Class V authorization to TexCom to re-perforate proposed WDW-410 as set forth in TexCom's pending application for a Class I authorization, and conduct the fall-off test I've been describing.

**APPLICANT OFFERS TEXCOM EX. 90**

Q: PLEASE DESCRIBE YOUR ROLE IN PERFORMING THE SEPTEMBER 2009 FALL-OFF TEST AT PROPOSED WDW-410.

A: I prepared the work plan and was the principal engineer overseeing all aspects of the re-perforation and fall-off test. The on-site work was performed by multiple sub-contractors, including Gulf Coast Vacuum Service (which brought in 15 frac tanks and filled them with clean brine from Texas Brine Corporation), Torqued-Up Energy Services (which conducted the nitrogen backwash and acidization on proposed WDW-410), and Wood Group Logging (which performed the re-perforation and fall-off test).

Q: PLEASE DESCRIBE HOW THE ON-SITE WORK WAS PERFORMED.

A: The on-site work was performed over a seven-day period between September 8 and September 15, 2009 according to a detailed, step-by-step work plan that had been included at Attachment B-1 to the application, which you have marked as TexCom Ex. 89. There were basically four aspects to the on-site work: (1) well perforating, (2) nitrogen backwash and acid treatment, (3) mechanical integrity testing, and (4) injection/fall-off testing. Daily summaries of the on-site work can be found in an October 2009 report entitled, "TexCom Gulf Disposal, LLC, Proposed WDW-410 Well Perforating and Testing Report."

Q: I AM SHOWING YOU WHAT HAS BEEN MARKED AS TEXCOM EX. 91. COULD YOU PLEASE IDENTIFY THIS DOCUMENT?

A: Yes, it is a true and correct copy of the report I just mentioned. This report, which I prepared, includes a thorough discussion of how the fall-off test was conducted, and an interpretation of the test results. Note that this version of the report does not include the CD of electronic modeling files that was included in the version that I understand was distributed to the parties last Fall.

Q: DO YOU ADOPT THE INFORMATION IN THIS REPORT AS YOUR TESTIMONY IN THESE PROCEEDINGS?

A: Yes.

**APPLICANT OFFERS TEXCOM EX. 91**

Q: YOU MENTIONED THAT MECHANICAL INTEGRITY TESTING WAS PART OF THE ON-SITE WORK. HOW WAS THIS DONE AND WHAT DID IT CONCLUDE?

A: The mechanical integrity testing was done with both an annular pressure test and radioactive tracer survey. These are described in some detail in the report marked as TexCom Ex. 91. Consistent with previous testing performed on this well, this testing indicated that proposed WDW-410 has mechanical integrity. In other words, there are no punctures, cracks, separations or other defects that would allow injected wastewaters to escape into any zones prior to reaching the injection interval at the bottom of the well.

Q: WERE TCEQ PERSONNEL PRESENT DURING ANY PART OF THE ON-SITE WORK?

A: Yes, Richard Heitzenrater and another TCEQ employee observed the mechanical integrity testing aspect of the on-site work.

Q: WHAT WERE THE RESULTS OF THE FALL-OFF TEST?

A: The fall-off test indicated a permeability of 190.6 md, although I believe that, based on the results for another parameter measured during the fall-off test, known as the "skin factor," the permeability of the injection interval is actually higher than 190.6 md.

Q: WHAT IS "SKIN FACTOR?"

A: Skin factor is a measurement of initial resistance met by the injected fluid at the bottom of the well. A high skin factor, such as the skin factor of 22.7 determined in the course of the fall-off test at proposed WDW-410, is indicative of some near-well formation

damage, such as clogging of the perforations that was not effectively removed by the well backwash or acid treatment. Any such clogging of the perforations will be eliminated within the first few weeks of injection activities.

Q: WERE YOU SURPRISED BY THE RESULTS OF THE FALL-OFF TEST?

A: Yes, to a degree. I thought the fall-off test would indicate a permeability of closer to 500 md, the value I assumed in the original modeling I performed for TexCom's application. However, as I've been explaining, the lower-than-expected permeability of 190.6 md is very likely the result of some near-well formation damage or clogging of the perforations. Also, keep in mind that 190.6 md is actually closer to 500 md than you might think. This is because there is a non-linear correlation between a numeric representation of permeability and the formation's capacity to absorb wastewaters. In fact, in terms of the formation's capacity to absorb wastewaters, 190.6 md is a lot closer to 500 md than it is to 80.9 md, the value TexCom was ordered by the Commission to use in its supplemental modeling.

Q: DO THE RESULTS OF THE FALL-OFF TEST CHANGE ANY OF YOUR OPINIONS ABOUT THE SAFETY OF TEXCOM'S PROPOSED INJECTION ACTIVITIES?

A: No. As I explained earlier, in accordance with the Commission's Interim Order, I assumed a permeability of 80.9 md in conducting my March 2009 modeling. That modeling showed that the down-hole pressures, even after 30 years of continuously injecting at maximum permitted rates, would not exceed the pressures needed to fracture the formation, and that the AOR would not extend beyond 2.94 miles within the Conroe Oil Field, in which all wells are completed in the Upper Cockfield. If the permeability is

actually 190.6 md then the down-hole pressure build-up will be even less, and the AOR would be smaller. To determine how much smaller, in October of 2009 I performed a modeling exercise using a permeability value of 190.6 md. Details regarding this modeling exercise can be found in the report you have marked as TexCom Ex. 91.

Q: IN CONDUCTING YOUR OCTOBER 2009 MODELING EXERCISE, DID YOU FOLLOW THE SAME METHODOLOGIES USED IN THE MARCH 2009 MODELING EXERCISE YOU DISCUSSED EARLIER?

A: Yes. The only difference was that I assumed a permeability value of 190.6 md instead of 80.9 md.

Q: WHAT WERE THE RESULTS OF YOUR OCTOBER 2009 MODELING EXERCISE?

A: My October 2009 modeling exercise determined the cone of influence to have a radius of approximately 3,500 feet based on an injection interval permeability of 190.6 md. Notice that this is much closer to the 750-foot radius calculated assuming a permeability of 500 md, than it is to the 2.94-mile radius calculated assuming a permeability of 80.9 md. This demonstrates the non-linear relationship between a numeric representation of permeability in millidarcies and the formation's actual capacity to absorb injected wastewater I mentioned earlier.

Because 3,500 feet is less than 2.5 miles, TCEQ rules would call for the radius of the AOR to be set at the default 2.5 miles under this modeling scenario, capturing the same 505 wells identified in the original application. The fall-off test results, therefore, validated the original scope of review for this project.

Q: BUT WOULDN'T THE CONE OF INFLUENCE CAPTURE MORE WELL LOCATIONS AS COMPARED TO THE CONE OF INFLUENCE CALCULATED ASSUMING A PERMEABILITY OF 500 MD?

A: Yes, a 3,500-foot radius cone of influence would capture more well locations than a 750-foot radius cone of influence. But they would be a subset of the 514 well locations captured by the 2.94-mile cone of influence calculated by my March 2009 modeling exercise (80.9 md) and listed in the spreadsheet marked as TexCom Ex. 88. As I discussed earlier, none of these wells are open conduits to the Lower Cockfield.

Q: WHICH OF THE MODELING EXERCISES IS THE RIGHT ONE, IN YOUR OPINION? THE ORIGINAL MODELING (500 MD), THE MARCH 2009 MODELING (80.9 MD) OR THE OCTOBER 2009 MODELING (190 MD)?

A: Well, it really doesn't matter which of three modeling exercises you label as "the right one," since the results of all three are that the fracture pressure will not be exceeded, and the cone of influence will not extend beyond the boundaries of the Conroe Oil Field, in which all wells were completed in the Upper Cockfield. Furthermore, it is more appropriate to think of these modeling exercises as making assumptions of varying levels of conservativism, as opposed to being either right or wrong. After all, even when we assumed a permeability of 500 md, we made several other extremely conservative assumptions (including maximum injection rates, 24 hours a day, seven days a week, 365 days a year for 30 years) that more than offset an overestimation of the permeability. But, even if we conservatively assume the permeabiliy is 190 md, or even more conservatively assume it is 80.9 md, the modeling shows that there is no possibility of

upward migration of wastewater into any aquifer, even with all of the conservativism built-into the modeling.

Q: FINALLY, THE APPLICATION FOR THE CLASS V AUTHORIZATION STATED THAT THE FALL-OFF TESTING WAS DESIGNED TO MAXIMIZE THE POTENTIAL FOR THE RADIUS OF INVESTIGATION TO REACH THE EW-4400-S FAULT THAT IS LOCATED TO THE SOUTH OF THE SITE.

DID THE RADIUS OF INVESTIGATION, IN FACT, REACH THE EW-4400-S FAULT?

A: No. The radius of investigation ended up being only approximately 2,583 feet due to the lower-than-expected permeability. The fall-off test, therefore, did not provide any new information about the EW-4400-S fault. It is worth noting, however, that, consistent with the fall-off test performed on proposed WDW-410 when it was previously permitted, and with both my testimony and Dr. Bruce Langhus's testimony from the first SOAH hearing, the fall-off test did not detect any faults within the approximately 2,583-foot radius of investigation.

## VI. CONCLUSION

Q: HAVING CONDUCTED TWO MORE MODELING EXERCISES, ONE BASED ON THE ASSUMPTIONS DIRECTED BY THE COMMISSION IN ITS DECEMBER 12, 2008 INTERIM ORDER, AND THE OTHER BASED ON THE RESULTS OF THE SEPTEMBER 2009 FALL-OFF TEST, DO YOU STILL BELIEVE THAT TEXCOM'S PROPOSED UIC FACILITY WILL BE PROTECTIVE OF ANY UNDERGROUND

WATER SUPPLIES, AND THAT TEXCOM HAS MET ALL OF TCEQ'S REQUIREMENTS TO BE ISSUED CLASS I AUTHORIZATIONS?

A: Yes. Modeling using the conservative assumptions directed by the Commission demonstrates that the proposed wells will be protective. The fall-off test results only further prove the conservativism of that modeling analysis.

## EXHIBIT LIST

| | |
|---|---|
| **TexCom Ex. 84** | Greg Casey's Supplemental Pre-filed Testimony |
| **TexCom Ex. 85** | Modeling Report (Assuming a Permeability of 80.9 md and Treating the EW-4400-S Fault as Non-Transmissive) |
| **TexCom Ex. 86** | Hypothetical 2.94-mile AOR Map |
| **TexCom Ex. 87** | Records for all wells within hypothetical 2.94-mile AOR |
| **TexCom Ex. 88** | Spreadsheet summarizing records for wells within hypothetical 2.94-mile AOR |
| **TexCom Ex. 89** | TexCom's May 5, 2009, application for Class V authorization |
| **TexCom Ex. 90** | TCEQ's July 23, 2009 letter granting Class V authorization for September 2009 fall-off test at proposed WDW-410 |
| **TexCom Ex. 91** | "TexCom Gulf Disposal, LLC, Proposed WDW-410 Well Perforating and Testing Report" (October 2009) |